Did FDICIA Enhance Market Discipline?
A Look at Evidence from the Jumbo-CD Market

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Abstract

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JEL Codes: *G21, G28, K23*
Keywords: *Market Discipline, Jumbo Certificates of Deposit, FDICIA, Bank Supervision*

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1. Introduction[*]

Did the Federal Deposit Insurance Corporation Improvement Act of 1991 (FDICIA) strengthen depositor discipline on risky banks? This question is important because considerable energy has been devoted in the Basle countries to erecting a debt-market pillar for bank supervision. Advocates argue that high-powered incentives in debt markets—particularly the subordinated-debt market—produce accurate assessments of bank risk. In turn, these assessments—manifested through changes in yields or ease of "rollovers"—pressure bank managers to maintain safety and soundness. Although this argument has considerable appeal—and has proved quite persuasive in policy circles—the supporting evidence is thin. The evidence does suggest that risk assessments are impounded into the price of bank debt, though most papers have taken statistical significance to imply economic importance. (See Flannery, 1998, for a survey of this literature.) But there is little evidence that risk assessments impel bank managers to contain risk (Bliss and Flannery, 2001). Provisions of FDICIA forced uninsured creditors to bear much more of the losses from bank failures. Because no other federal laws affecting loss exposure took effect in the surrounding years, the Act offers a natural experiment for assessing the supervisory returns from greater reliance on debt markets to police bank risk.

The market for jumbo certificates of deposit (CDs) offers a natural place to assess the impact of FDICIA on debt-market discipline. Jumbo CDs are time deposits with balances above the $100,000 deposit-insurance ceiling. These deposits are an important funding source for both large banks and community banks. At year-end 2002, banks holding more than $500 million in assets (1999 dollars) funded 11.9 percent of assets with jumbo CDs (unweighted mean). For banks holding less than $500

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million in assets—the cutoff for a community financial institution under the Financial Modernization Act of 1999—the ratio was 12.8 percent. Jumbo CDs have also become a more important part of bank capital structure in recent years. At year-end 2002, U.S. commercial banks funded 12.7 percent of assets with jumbo CDs, up from 7.2 percent at year-end 1993.[1] A robust finding from research on pre-FDICIA samples is that jumbo-CD yields exhibit some sensitivity to failure risk and did so even during periods when government policy extended de facto insurance to all liabilities. (See Table 1 for a review of prior research.) Evidence that FDICIA magnified this risk sensitivity would strengthen the case for formalizing debt-market discipline as a pillar in bank supervision.

We use a six-step research strategy to evaluate FDICIA's impact on the strength of discipline from the jumbo-CD market. First, we specify clean test windows before and after the Act. Second, we identify a suitable sample of banks for each test window. Third, we draw on the income statements and balance sheets of the sample banks for measures of jumbo-CD yields and run-offs as well as a summary statistic for bank risk. Fourth, we regress yields and run-offs on the summary statistic inside of each test window, holding other influences constant with appropriate control variables. Fifth, we apply the estimated risk coefficients to the financial statements of the sample banks to infer the impact of risk on profitability in each test window. Finally, we assessed the impact of FDICIA on depositor discipline by inspecting the difference in the profit price of risk in the pre- and post-Act windows.

Taken together, the evidence suggests that the jumbo-CD market applied little pressure on risky banks before or after FDICIA. Yields and run-offs reacted to failure risk in both test windows, but the estimated sensitivity was small. Moreover, this sensitivity did not differ statistically or economically across the two sample windows. More to the point, changes in risk had a trivial impact on bank profits before and after the Act. This evidence has three policy implications. First, in the current institutional and economic environment, the jumbo-CD market offers little support for supervisory efforts to contain

1. Average jumbo-CD dependence hovered between 10 and 11 percent of assets from 1984 to 1990. Then, the jumbo-CD-to-asset ratio dropped sharply, reaching a nadir in 1993 at the 7.2 percent figure cited in the text. The decline can largely be traced to increases in capital requirements mandated by the Basle Accords.

bank risk. Second, proposed increases in the deposit-insurance ceiling will not exacerbate moral hazard by weakening depositor incentives to monitor and discipline risk. Third, and most important, the benefits of compelling banks to issue subordinated debt for supervisory purposes may have been overstated. We conclude with a cautionary note: the unusual sample periods, one of which includes the longest business-cycle expansion in U.S. history, may play a role in the findings. Before dismissing the supervisory value of debt-market discipline, we must examine evidence from all phases of the business cycle. Still, policy discussion to date has implicitly assumed that debt-market discipline is equally vigorous in all states of the world. At the very least, our evidence points to time variation that may necessitate a reassessment of the supervisory value-added by such discipline.

2. Prior research on FDICIA

At the time it was enacted, FDICIA marked the most sweeping changes in bank regulation since the 1930s. Event-study evidence suggests that these changes collectively increased bank-stockholder wealth (Akhigbe and Whyte, 2001). Specifically, these regulatory changes included prompt corrective action (PCA) and mandatory regular examinations. Of the two, prompt corrective action has received more scientific study. The evidence suggests that PCA capital thresholds were set too low and, as a result, would have made little difference in the banking crisis of the 1980s (Peek and Rosengren, 1997; Jones and King, 1995; Gilbert, 1992). Increased exam frequency has also received some attention, with the evidence suggesting that annual full-scope exams would have reduced losses to the deposit-insurance fund (Gilbert, 1993).

FDICIA also brought regulatory changes with implications for the effectiveness of debt-market discipline. One such change was a reduction in "too big to fail" protection for large banks. In May 1984, concerns about systemic risk led regulators to shield all creditors of Continental Illinois from losses when the bank became insolvent. That September, the Comptroller of the Currency formalized the policy in Congressional testimony by announcing that the eleven largest national banks were too big to fail. The equity markets immediately priced a reduction in risk for all large publicly traded banking organizations

(O'Hara and Shaw, 1990). Later, the subordinated-debt market priced an increase in risk as regulators informally distanced themselves from the policy (Flannery and Sorescu, 1996). FDICIA codified this distance by requiring the consent of the Secretary of the Treasury, along with two-thirds majorities of the Board of Governors of the Federal Reserve and the directors of the FDIC, before an institution can be declared too big to fail. Regulatory resolve has yet to be tested, but the consensus view is that FDICIA exposed uninsured creditors of large banks to default risk (Benston and Kaufman, 1998).

Another change with implications for debt-market discipline was least-cost failure resolution. Before 1991, the FDIC cleaned up most failures with purchases and assumptions. In these resolutions, the FDIC offered cash to healthy banks to assume the liabilities of failed ones, in effect protecting all uninsured creditors against losses. FDICIA directed the FDIC to resolve failures in the least expensive fashion, meaning that uninsured creditors—like jumbo-CD holders—had to share in the losses. The post-Act numbers point to heightened exposure. In the three years running up to FDICIA (1988 through 1990) jumbo-CD holders suffered losses in only 15 percent of the bank failures. From 1993 to 1995, uninsured depositors lost money in 82 percent of the failures (FDIC data reported in Benston and Kaufman, 1998). The new resolution procedure should have prompted jumbo-CD holders to pay more attention to bank risk, particularly in light of the new restrictions on too big to fail.

Despite its potential importance for the market-discipline debate, evidence from regulatory regime changes in general and from FDICIA in particular is sparse. Flannery and Sorescu (1996)—as already noted—examine subordinated-debt-holder reaction to the U.S. government's retreat from the too big to fail policy. In addition, Martinez Peria and Schmukler (2001) study depositor reaction to banking crises in Argentina, Chile, and Mexico—finding that such crises prompt depositors to monitor and discipline bank risk. Only three papers look at FDICIA either indirectly or directly. Billet, Garfinkel, and O'Neal (1998) touch on the issue indirectly, arguing that risky banks used insured deposits to escape market discipline before and after FDICIA. They examine banks that experienced bond-rating changes between 1990 and 1995 and conclude that the mix of insured and uninsured funding reacted to upgrades and downgrades in both regulatory regimes. Jordan (2000) finds similar patterns in a sample of New England banks that failed in the late 1980s and early 1990s, though only a handful of his observations come from the post-FDICIA period. Goldberg and Hudgins (2002) tackle the issue directly, examining jumbo-CD run-off at failing thrifts before the Financial Institutions Reform, Recovery, and Enforcement Act of 1989 (FIRREA) and after FDICIA. They note significant run-off as failure approached, run-off they ascribe to depositor discipline, both before and after FIRREA/FDICIA.

The only paper coming near our research question—the Goldberg-Hudgins paper—suffers from two shortcomings. First, the study looks only at deposit run-off, a problematic approach because uninsured depositors can react to rising failure risk by demanding higher yields or withdrawing funds. Indeed, most studies have gone to the other extreme and examined only yields. (Again, see Table 1 for a review of prior research.) We examine yields as well as run-off. Second, and more important, the Goldberg-Hudgins study suffers from an observational-equivalence problem: observed run-off could reflect supervisor discipline rather than depositor discipline. Banks approaching failure typically operate under formal enforcement actions mandating improvement in regulatory-capital ratios (Gilbert and Vaughan, 2001). One way to improve capital ratios quickly is to allow high-cost funding—jumbo CDs, for example—and low-yield loans to run off. Previous research has documented significant loan and deposit shrinkage at banks under enforcement actions (Peek and Rosengren, 1995). Table 2 complements this research with evidence of loan and deposit shrinkage at Fed-supervised banks that failed in the 1990s. Of the 28 banks that failed, 24 operated under enforcement actions at failure. The mean age of these actions at failure was 6.8 quarters. (Goldberg and Hudgins track run-off starting eight quarters before failure.) Beginning about six quarters before failure—about the time enforcement actions were imposed—the 24 banks began to shrink. Indeed, jumbo CDs ran off faster than core deposits, so the ratio of jumbo CDs to total deposits declined as well. Because jumbo-CD run-off at failing institutions may reflect management reaction to enforcement actions rather than depositor reaction to failure risk, the Goldberg-Hudgins evidence is hard to interpret. To avoid this problem, we supplement our baseline analysis with an analysis of a sub-sample free of formal enforcement actions. Evidence from these banks reflects only the interaction of the jumbo-CD market and bank management.

3. Research strategy

We relied on quarterly data for U.S. commercial banks, collected for three years running up to FDICIA (1988-90) and three years after FDICIA began to take effect (1993-95). Specifically, we used income-statement and balance-sheet numbers from the Reports of Condition and Income (the call reports), which are collected under the auspices of the Federal Financial Institutions Examination Council (FFIEC). Most of these data are available to the public. We also tapped non-public supervisory ratings from the National Information Center database of the Federal Reserve System. The event period is the interval running from the first quarter of 1991 to the fourth quarter of 1992. We began the pre-FDICIA sample in 1988 and ended the post-FDICIA sample in 1995 because call-report changes made construction of consistent controls for jumbo-CD maturity problematic before and after these years. Another reason to end the sample in 1995 is the Riegle-Neal Interstate Banking and Branching Efficiency Act. This Act passed in 1994 but took effect in two stages. In the fourth quarter of 1995, the last quarter of our post-FDICIA window, multi-bank holding companies were freed to acquire banks in other states. This provision does not affect our analysis because our focus is at the bank level, and we control for holding-company affiliation. In the second quarter of 1997, however, banks in separate states were permitted to merge into a unified branch network. This provision would affect our post-FDICIA analysis if jumbo-CD holders priced expected reductions in risk arising from greater geographic diversification. Ending the sample in 1995 largely eliminates this problem because the average maturity of jumbo-CDs in our post-FDICIA sample is 0.85 years (standard deviation = 0.46).

We required all sample banks to pass a jumbo-CD usage test as well as an operating-history test, and we isolated a sub-sample that operated free of formal enforcement actions. All sample banks had to hold more than $5 million in jumbo CDs. We used this threshold to eliminate outliers and to ensure the importance of jumbo-CD funding for all sample banks. In addition, each sample bank had to have a five-year operating history. We excluded de novos because their financial ratios take extreme values that do not necessarily imply significant failure risk (DeYoung, 1999). Finally, to eliminate any influence of enforcement actions, we also carved out a sub-sample of banks considered by supervisors to be in "satisfactory" condition. We used a satisfactory-CAMEL-composite rating as a proxy for the absence of enforcement actions because consistent pre-1990 data are not available from all three Federal bank regulators and satisfactory institutions are typically free of safety-and-soundness-related actions.[2] Supplementing the baseline analysis with analysis of a satisfactory-CAMEL sub-sample not only eliminates the observational-equivalence problem noted earlier, it also indicates whether the jumbo-CD market imposes any discipline on banks headed for, but not yet in, financial distress. Debt-market discipline would offer the most benefit to supervisors if some check on risk were applied before formal intervention was necessary.

Our dependent variables are accounting-data-based measures of jumbo-CD yield and run-off. Our run-off measure—quarter-over-quarter changes in jumbo-CD balances—comes directly from the balance sheets of each sample bank. Our yield measure was computed in two steps. First, quarterly jumbo-CD interest expense (lifted from the income statements of the sample banks) was divided by average quarterly jumbo-CD balances (lifted from the balance sheets). Then, this average yield was combined with maturity-matched Treasury yields and appropriate control variables to produce proxies for default premiums. Only a handful of money-center banks issue jumbo CDs that trade in deep secondary markets, so reliable real-time market yields are not available for most banks. Our approach permits computation of jumbo-CD yields for every FFIEC-reporting institution. Other researchers have successfully used this approach to test hypotheses about bank risk (for example, James, 1988; Keeley, 1990; and, more recently, Martinez Peria and Schmukler, 2001). Figure 1 tracks the sample mean of our

2. In the test windows, CAMEL composites reflected on-site examiner assessments of five components of safety and soundness—capital protection (C), asset quality (A), management competence (M), earnings strength (E), and liquidity-risk exposure (L). Explicit assessment of market-risk sensitivity (S) was added to the CAMEL framework in 1997. Composite ratings represent overall assessments of bank condition and take integer values ranging from one (best) to five (worst). In general, banks with composite ratings of one or two are considered satisfactory while banks with ratings of three, four, or five are considered unsatisfactory.

yield measure along with various money-market rates from 1988 to 1995. Our measure closely tracks market yields on instruments with comparable maturities, albeit with a lag.

Following previous studies, we modeled jumbo-CD yields and run-offs as functions of a summary statistic for bank risk and a vector of control variables. Specifically, we estimated these regressions for the pre-FDICIA and the post-FDICIA windows:

$$P_{i,t} = \sum_{j=1}^{3} \beta_j \pi_{i,t-j} + \gamma' \chi_{i,t} + \varepsilon_{i,t} \tag{1}$$

$$Q_{i,t} = \sum_{j=1}^{3} \delta_j \pi_{i,t-j} + \varphi' \chi_{i,t} + \upsilon_{i,t} \tag{2}$$

where $P_{i,t}$ is the average jumbo-CD yield at bank i in quarter t, $Q_{i,t}$ is the percentage change in jumbo-CD balances at bank i over quarter t, $\pi_{i,t-j}$ is the lagged probability of failure (described below), $\chi_{i,t}$ is a vector of control variables, β and δ and the vectors γ and φ are ordinary-least-squares (OLS) regression coefficients, and $\varepsilon_{i,t}$ and $\upsilon_{i,t}$ are error terms with the standard properties. A three-lag structure for failure probability was chosen to span the average jumbo-CD portfolio maturity of the sample banks.[3] We omitted the contemporaneous quarter to avoid simultaneity.

Another novel aspect of our research strategy—besides use of a satisfactory-CAMEL sub-sample—is the summary statistic for bank risk. Previous researchers either used an ad hoc set of accounting ratios to capture different dimensions of bank risk or estimated a failure-prediction model for the paper and used that model to generate a summary statistic. We instead relied on the failure probability generated by the System to Estimate Examination Ratings (SEER)—the model used by the Federal Reserve in off-site monitoring. SEER draws on the latest call-report data for all U.S. commercial banks to estimate the probability that each bank will fail within the next two years. The financial ratios in the model include proxies for credit risk, liquidity risk, and leverage risk, along with a control variable for

3. For example, the average maturity of jumbo-CD portfolios is 0.53 years (standard deviation = 0.30) in the pre-FDICIA period and 0.85 years (standard deviation = 0.46) in the post-FDICIA period.

bank size. (Table 3 describes these variables and notes the relationship between each variable and failure probability.) Extensive in- and out-of-sample validation tests were performed on SEER during development in the early 1990s (Cole, Cornyn, and Gunther, 1995), and the surveillance section at the Board of Governors continues to validate the model annually. Finally, recent research has validated SEER in out-of-sample performance tests against other surveillance tools (Gilbert, Meyer, and Vaughan, 2002). Previous work tested a joint hypothesis—the measures in the paper produce an accurate picture of bank risk, and debt holders price bank risk. Our reliance on a failure-prediction model actually used in surveillance permits a cleaner test of the second hypothesis.

A final noteworthy aspect of our research strategy is the vector of control variables. Broadly speaking, other studies have used proxies for idiosyncratic aspects of the jumbo-CD portfolio, idiosyncratic aspects of the issuing bank, and current conditions in the money market. Time dummies have been added to capture the impact of any omitted variables. The specific controls used, however, have varied considerably across the studies, and the union of all these controls still excludes bank-specific variables likely to influence yields and run-offs in our test windows. So we conducted a fresh specification search, starting with a list of candidate variables drawn from examiner suggestions, previous jumbo-CD research, and related market-discipline studies. We opted for OLS with a fresh, expansive set of control variables rather than fixed effects because most sample variation is across banks, and fixed effects would sweep out much of this variation. Table 4 contains a summary description of our control variables.

The control vector included proxies for interest-rate-risk premiums and liquidity-risk premiums as well as for overall money-market conditions. We controlled for the percentage of the jumbo-CD portfolio with fixed (as opposed to variable) rates because depositors exposed to more interest-rate risk should demand higher yields. The maturity-weighted risk-free rate for term premiums paid by each and for the general level of interest rates. We obtained this measure by multiplying the proportion of each bank's CDs in each call-report maturity bucket—"less than three months remaining," "three months to one year remaining," "one year to five years remaining," and "over five years remaining"—by the yield on comparable-maturity Treasuries in that quarter. As a further term-to-maturity and liquidity control, we included each bank's average jumbo-CD maturity. Finally, we attempted to control for the impact of negotiability on yield. The call report does not record jumbo-CD negotiability, so we employed a dummy for institutions ranking among the largest 25 U.S. banks by assets. We used this approach because only large, money-center banks routinely issue negotiable instruments.

We tapped one other related control to reduce problems arising from the use of average yields. Specifically, we added an interactive variable equal to the product of the two-quarter lag of each bank's average jumbo-CD maturity and the most recent two-quarter change in the maturity-adjusted risk-free rate. Our yield measure conflates rates paid on seasoned instruments with rates paid on fresh issues. As a consequence, measured yields for banks with shorter average jumbo-CD maturities adjust faster to changes in market rates and failure probabilities than measured yields for banks with longer maturities. Including this control is particularly important to our analysis because interest-rate volatility differed significantly across the sample windows—the standard deviation of the maturity-weighted Treasury rate is 0.58 percent for the pre-FDICIA window and 1.16 percent for the post-FDICIA window.

We also controlled for holding-company affiliation of the issuing bank, the geographic location of the issuing bank, and the overall funding needs of the issuing bank. First, jumbo-CD holders may have looked past the bank to the holding company. For example, in the late 1980s—corresponding to our pre-FDICIA window—Texas holding companies were sources of weakness for subsidiary banks. Dozens of healthy subs were shuttered when regulators closed the lead bank (Cannella, Fraser, and Lee, 1995). In such an environment, jumbo-CD holders may have priced the weak condition of the holding company or the lead bank rather than the strong condition of the subsidiary. As a control, we assigned dummies to sample banks that belonged to a holding company. Second, power in the local deposit market could have enabled a bank to pay less than the going jumbo-CD rate (Berger and Hannan, 1989), so we included a dummy for banks in a Metropolitan Statistical Area (MSA) on the premise that urban banks face more competition. Finally, to hold funding demand constant, we employed a dummy for sample banks that used brokered deposits. Some banks can satisfy their funding needs with locally sold jumbo CDs. Yields and run-offs for these instruments show little sensitivity to money-market conditions or failure-risk probability because of retail adjustment costs (Flannery, 1982). “Going national” for funding means paying the going risk-adjusted rate. Deposit brokers move blocks of insured deposits around the country in search of the highest yield. FIRREA restricted brokered-deposit usage by weakly capitalized institutions, and examiners frown on them even in healthy banks. Thus, reliance on such deposits provides strong evidence that a bank’s funding demand exceeds available supply.

We rounded out the control vector with state and quarter dummies. The state dummies were inserted to pick up differences in regional economic conditions, state banking laws, and state income-tax codes. We used dummies to control for the state economic environment because bank conditions in the 1990s did not correlate with county-level economic data (Meyer and Yeager, 2001). State-level controls could also pick up differences in banking concentration not captured by the MSA dummy. The quarter dummies controlled for seasonal fluctuations in deposit and money-market conditions and for business-cycle fluctuations inside of each sample window. They also controlled for the reduction in jumbo-CD reserve requirements near the end of the pre-FDICIA sample, a cut that should have affected both yields and balances (Cosimano and McDonald, 1998). Finally, the quarter dummies controlled for differences in the FDIC’s credibility as deposit insurer. The first $100,000 of a jumbo CD is insured. Cook and Spellman (1994) find that retail deposits carried varying risk premiums over our sample period because of variation in the condition of the deposit-insurance fund. With a different sample and a different empirical strategy, Cooperman, Lee, and Wolfe (1992) also find evidence of time-varying risk premiums on insured deposits.

Table 5 provides summary statistics for the pre- and post-FDICIA samples. Means for the independent and dependent variables differ across sample periods at the one-percent level of significance. The data reveal that jumbo-CD yields declined with money-market rates from the pre- to post-FDICIA periods. Bank condition also improved after FDICIA, reflecting Basle-mandated increases in capital ratios, exit of weakly capitalized institutions, and recovery from the 1990-91 recession. Improvements in overall bank condition can be traced to less commercial lending, stronger asset quality, lower liquidity risk, and lower leverage risk. Another risk-reducing factor was size; post-FDICIA banks were larger than pre-FDICIA banks, reflecting industry consolidation. Finally, on average post-FDICIA banks used less jumbo-CD funding than pre-FDICIA banks, largely due to higher capital requirements associated with the Basle Accords.

Even with the post-FDICIA improvement in banking conditions, the sample is heterogeneous in both windows. For the 1988-90 sample, the standard deviation of failure probability is 15.70 percentage points (mean 5.04 percent), implying a coefficient of variation of 3.12. For the 1993-95 sample, the standard deviation is 8.15 percentage points (mean 1.24 percent), yielding a coefficient of variation of 6.57. Interestingly, summary statistics for the satisfactory-CAMEL sub-sample (not shown in the table) point to heterogeneity among currently safe-and-sound banks. The pre-FDICIA coefficient of variation for failure probability is 4.14, while the post-FDICIA figure is 7.35. Mean and median failure probabilities are low for both the pre- and post-FDICIA samples, but low failure probabilities do not automatically imply weak discipline in the jumbo-CD market. Jumbo-CD holders price expected losses, not failure probability alone, and FDICIA substantially increased losses given failure. Only empirical tests can determine the combined impact of changing failure probability and loss given failure on jumbo-CD discipline. Moreover, average failure risk for those banks potentially subject to mandatory subordinated-debt issue is lower than average failure risk for our sample banks—both before and after FDICIA. Indeed, for the largest 50 U.S. banks, mean failure probability between 1993 and 2002 was 0.10 percent. This low failure probability has not deterred the Basle committee from studying the feasibility of mandatory sub debt.

4. Empirical results

4.1 Baseline sample

The yield and run-off equations fit the pre- and post-FDICIA data well. (Tables 6 and 7 contain these regression results.) In all four equations, the block of bank-specific control variables is jointly significant; in most cases, the individual bank-specific controls are significant with the expected signs as well. The blocks of state and quarter dummies are also strongly significant. The R^2s are low but consistent with magnitudes reported in other studies. Particularly noteworthy is the 0.41 R^2 in the post-FDICIA yield regression. This high figure stems from the combined effects of greater interest-rate variability in the second period (see Figure 1) and sluggishness of average yields. When interest rates are stable, the variables tracking maturity structure—the average maturity, the maturity-weighted risk-free rate, and the interactive maturity variable—account only for the effect of term-structure premiums, not for the effect of different rates paid on seasoned CDs. When rates fluctuate markedly, however, yields at banks with short average maturities align more closely with market rates than yields at "long-maturity" banks, and the maturity variables capture most of the variation in yields. This phenomenon also explains the higher statistical significance of maturity variables in the post-FDICIA period.

The signs and magnitudes of the failure-risk coefficients in the yield and run-off equations speak to the strength of jumbo-CD discipline. Positive, statistically significant, summed coefficients for the yield equations and negative, statistically significant, summed coefficients for the run-off equations indicate some discipline—that is, increases in failure probability translate into higher yields and greater run-off. A statistically significant increase in the sum of the risk coefficients in the post-FDICIA window relative to the pre-FDICIA window would imply stronger jumbo-CD discipline following the Act.

The evidence is consistent with some jumbo-CD discipline in both the pre- and post-FDICIA windows; at the same time, the evidence does not point to a change in the intensity of that discipline. The summed failure-risk coefficients are significant at the one-percent level in the yield equations for both periods. For the pre-FDICIA sample, a one-percentage-point increase in SEER failure probability boosted jumbo-CD yields by 0.34 basis points; for the post-FDICIA sample, one-percentage-point increase lifted yields by only 0.24 basis points. The difference between the two coefficients has an unexpected sign but is statistically insignificant (p-value = 0.56), so we cannot rule out the possibility that risk sensitivities in the two periods are equal. In the run-off equations, the summed coefficient on failure probability is negative and significant at the one-percent level in the pre-FDICIA period; the coefficient estimate implies that a one-percentage-point increase in failure probability reduced the growth rate of jumbo-CD balances by 11-basis points. In the post-FDICIA period, the summed failure-risk coefficient is also negative and significant; the coefficient estimate implies that a one-percentage point increase in failure probability translated into a 12-basis-point run-off of jumbo CDs. The difference between the pre-FDICIA and post-FDICIA summed run-off coefficients has the expected sign but, again, is not statistically significant (p-value = 0.49).

The failure-risk coefficients in the yield and run-off regressions—both before and after FDICIA seem economically small. To get a sense for how small these summed coefficients really are—in each sample window and across the sample windows—we examined the profitability penalty for risk-taking implied by the estimated magnitudes. Specifically, we computed the difference in return on assets—a common measure of bank profitability—that would have obtained between a safe bank and a risky bank in each window, assuming that the banks conformed to sample averages in every other respect. To gain additional insight into FDICIA's impact, we also applied the post-Act penalties for risk taking to the average pre-Act bank. This approach controls for differences in capital ratios across periods resulting from imposition of the Basle Accords (Aggarwal and Jacques, 2001; Wall and Peterson, 1995). We defined a safe bank and a risky bank with extreme values—zero-percent failure probability and 100-percent failure probability—to provide upper bounds for assessments of economic significance. The regression results show that in both periods risky banks would have paid higher yields and would have issued fewer CDs. Return on assets would, therefore, have been influenced by four separate effects: the higher interest expense on newly issued jumbo CDs, the shift from jumbo CDs to other types of funding, the foregone revenue from slower asset growth, and the smaller asset base as ROA denominator. To isolate the impact through the jumbo-CD channel, we assume that all run-off was reflected one-for-one in assets and that yields on other bank assets and liabilities remained constant.

The estimated profitability penalties confirm that the jumbo-CD market imposed little discipline on risk taking in the pre- or post-FDICIA windows. Under our assumptions, moving from zero-percent failure probability to 100-percent failure probability in the pre-FDICIA period would have reduced ROA by 2.9 basis points—just 3.9 percent of the mean ROA value for 1988-90 and 2.2 percent of the standard deviation. In the post-FDICIA sample, the profit price of risk was smaller—ROA would have fallen just 1.3 basis points, a figure equal to 1.2 percent of the 1993-95 mean and 1.5 percent of the standard deviation. If the average pre-FDICIA bank had paid the post-FDICIA penalty for risk, a zero-to-100-percent rise in failure probability would have trimmed ROA by just 2.0 basis points. Under less extreme definitions of safe and risky banks—a one-percentage point increase in failure probability, for example—the profitability price of risk taking vanishes within and across windows. Put simply, the pre- and post-FDICIA evidence suggests that the ROA price for excessive risk imposed by the jumbo-CD market was very low and would have been difficult to separate from random fluctuation.

4.2 Satisfactory CAMEL sub-sample

As noted, the "unsatisfactory" (CAMEL-3, -4, or-5-rated) banks in the sample introduce the potential for an observational-equivalence problem: jumbo-CD run-off could reflect supervisor discipline, market discipline, or both. This problem does not appear to be serious here because the estimated risk sensitivities are small. But supervisor control over unsatisfactory banks could bias the SEER coefficients, accounting in part for small failure-risk sensitivities. When slapped with an enforcement action, unsatisfactory sample banks could have run-off extra-market funding quickly by lowering jumbo-CD rates. For such banks, risk and yields would be negatively correlated over the adjustment period (though risk and run-off would still be positively correlated). After the adjustment, the correlation between risk and yields or run-off would be weak because the remaining jumbo CDs are "core" deposits, that is, locally sold instruments whose supply is not interest-rate sensitive. Dropping unsatisfactory banks from the sample removes this potential bias. Even more important, it reveals how much pressure the jumbo-CD market brought to bear on banks prior to supervisory intervention before and after FDICIA. Such evidence is important because jumbo-CD discipline would be more valuable to supervisors if it checked risk before intervention were necessary.

Removing unsatisfactory-CAMEL banks sharpens the coefficient estimates, increasing risk sensitivities in each sample window as well as the differences across the windows. Removing these banks does not, however, alter the conclusions derived from tests on the full sample. (Table 8 contains summed failure-probability coefficients for the full sample, the satisfactory-CAMEL sub-sample, and the unsatisfactory-CAMEL sub-sample.) A one-percentage-point increase in SEER failure probability raised average jumbo-CD yield by 0.61 basis points in the pre-FDICIA period and 1.2 basis points in the post-FDICIA period. Meanwhile, a one-percentage-point increase in failure risk slowed the jumbo-CD growth rate by 13 basis points before FDICIA and 18 basis points after FDICIA. The differences in the yield and run-off coefficients across the two periods, however, are still statistically insignificant. More importantly, the profitability penalties implied by the coefficients are still trivial—in each period and across the periods. A zero-to-100-percent jump in failure probability would have reduced ROA by 3.6 basis points for the 1988-90 period—just 3.4 percent of the sub-sample mean ROA for the period and 2.8 percent of the standard deviation. For 1993-95, the increase in failure risk would have trimmed ROA by only 4 basis points—a figure equal to 2.8 percent of the period sub-sample mean and 6.1 percent of the standard deviation. If the average pre-FDICIA bank had paid the post-FDICIA risk penalty, a zero-to-100-percent rise in failure probability would have clipped ROA by just 5.5 basis points. This evidence implies that the jumbo-CD market imposed no effective check on risk-taking before supervisory intervention was necessary—either before or after FDICIA.

We investigated the robustness of our findings with different samples, different specifications, different controls, and different risk measures. Specifically, we examined the impact of asset size, deposits at risk, jumbo-CD dependence, and capital adequacy on risk sensitivity.[4] We split the sample at median values as well as "quartiling"—that is, estimating the yield and run-off regressions for the 25 percent of sample banks with the most assets, the most deposits at risk, the highest jumbo-CD dependence or the lowest capital ratios. In another test, sample banks not recently examined were excluded because their financial statements and CAMEL ratings could be inaccurate (Flannery and Houston, 1999; Cole and Gunther, 1998). As an additional check, yield and run-off regressions were estimated for 1997-2000.[5] We further experimented with a logarithmic specification and with varying lag structures (one to five quarters). We also tried other measures of the desired controls such as the sample bank's assets as a percentage of holding company assets (for holding-company status) and brokered deposits as a percentage of total assets (for overall funding needs). Finally, as alternative measures of risk, we used the probability a sample bank's supervisory rating will be downgraded to unsatisfactory status in the next 24 months as well the sample bank's "shadow" CAMEL rating—that is, an estimate of the rating that would have been awarded had the bank been examined in the observation quarter.[6] The results from all these tests were qualitatively similar to the results from the baseline tests.

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4. Deposits at risk are any uninsured deposit—that is, balances above $100,000 in checking, savings, or time deposits. Depositors with more exposure have greater incentive to monitor and discipline bank risk, so we estimated the yield and run-off regressions for the quartile of banks with the largest uninsured balances. The yield equations did show a slight, statistically significant, rise in risk sensitivity in the post-FDICIA period (relative to the pre-FDICIA period), but again this risk sensitivity was economically trivial.

5. In the 1997-2000 sample, a one-percentage-point increase in failure probability raised jumbo-CD yields by 0.69 basis points and slowed jumbo-CD growth by 16 basis points. The summed coefficients for yields and run-offs were higher in a statistical sense than the summed coefficients in the pre-FDICIA or immediate post-FDICIA (1993-95) period. But again, the implied profit price of risk through the jumbo-CD channel was trivial. In short, the jumbo-CD market still provides no effect check on bank risk-taking.

6. We did not test equity-market measures of risk for three reasons. First, doing so would restrict the analysis to publicly traded banks. Such a restriction would substantially reduce the size and variation of the sample. Second, other evidence suggests that accounting ratios like those in SEER collectively explain most of the variation in equity-market measures of total risk (Hall, King, Meyer, and Vaughan, 2003). Third, bank claimants (such as jumbo-CD holders) *should* and supervisors *do* price total risk, so decomposing that risk into systematic and idiosyncratic components would not furnish evidence relevant to the market-discipline debate. As Stulz (1999) has noted, capital markets should price idiosyncratic risk if a firm-specific shock could trigger sizable financial-distress costs. Supervisory intervention imposes sizable distress costs on banks. Indeed, supervisors wield power over banks that far exceeds the power creditors wield over non-banking firms. In any event, supervisors need evidence about the market's ability to check total risk because their charge is preventing failure—irrespective of whether it stems from a systematic or idiosyncratic shock.

Taken together, the evidence suggests that risk pricing was economically unimportant in the jumbo-CD market before FDICIA, and FDICIA did little to change that fact. Our evidence complements the Bliss and Flannery (2001) conclusion that markets apply little pressure on bank managers. They argue that financial markets price bank risk but that bank managers do not respond to these signals, perhaps because of agency problems. The findings presented here—based on a much larger and more heterogeneous sample than the Bliss-Flannery findings—suggest that the price of risk in the jumbo-CD market is so small that even managers devoted to maximizing shareholder value would not be deterred from risk taking.

5. Alternative explanations of the evidence

5.1 Measurement error

One possible non-economic explanation for our findings is that the distributed-lag model does not compensate adequately for measurement error. Our run-off variable is free of such error, but our yield variable is not because average accounting yields proxy for market yields. To see the issue, suppose two events occur at time t=0: a shock to money-market rates and a separate shock to failure risk at bank "i." The first shock will affect all money-market rates in t=1; the second will force bank "i" to pay a different rate on jumbo CDs issued in t=1. Our yield proxy will respond sluggishly because it conflates yields on seasoned instruments and yields on new issues. A lag structure for failure probability spanning the maturity of sample jumbo CDs corrects, in part, for the error associated with changing failure risk. But the error associated with changing money-market rates remains and could be pronounced if the average maturities of jumbo-CD portfolios for the sample banks are long and current market conditions are different from past market conditions.

Because the measurement error occurs in the dependent variable, the extent of bias in the failure-risk coefficients depends on the correlation of that error with failure probability. The correlation cannot, of course, be quantified precisely, but the data suggest it is low. For example, the quarterly correlation between average failure probabilities and changes in average secondary-market yields on six-month negotiable CDs is only 0.036 in the pre-FDICIA window and –0.006 in the post-FDICIA window—figures that differ statistically but not economically from zero. We imposed two assumptions on the data to get a clearer picture of the potential for bias. Rates paid on newly issued jumbo-CDs follow money-market rates closely, so we proxied quarterly changes in each bank's rate on new instruments with changes in the average secondary-market yield on six-month negotiable CDs. We then estimated the measurement error assuming each bank's jumbo-CD maturities were uniformly distributed. The resulting correlation between measurement error and failure probability is small: –0.027 before FDICIA and -0.003 after FDICIA. [7] As a final check, we subtracted these measurement-error estimates from average yields and re-estimated the yield equation (equation 1) for the pre- and post-FDICIA samples. This correction—which should have rendered any remaining bias second order—produced little change in the failure-risk coefficients. The "corrected" sum of lagged failure probabilities was 0.0034 for the pre-FDICIA period (identical to the uncorrected yield result) and 0.0020 (compared with 0.0025) for the post-FDICIA period. Put simply, measurement error does not explain the weak relationship between failure risk and jumbo-CD yields.

5.2 Depositor preference

We also estimated the yield and run-off regressions on a post-FDICIA sub-sample of banks holding no foreign deposits. The National Depositor Preference Act of 1993 elevated the claims of domestic depositors over the claims of foreign depositors (Marino and Bennett, 1999). At banks with substantial foreign-deposit cushions, expected losses for jumbo-CD holders would be negligible even if failure risk were high. Heavy reliance on foreign deposits among the sample banks could, therefore, explain the small, post-FDICIA, failure-risk coefficients. Excluding banks with foreign deposits, however, did not materially or statistically change the risk coefficients in either the yield or run-off

7. Even if failure-risk coefficients for the pre- and post-FDICIA samples are biased, differences in the coefficients across the two periods will be unbiased if the degree of measurement error is the same for each sample (Hoshi, Kashyap, and Scharfstein, 1991). Here, the data suggest that measurement error is trivial in each sample, implying that the difference in error across samples is trivial as well.

equations. In the yield regression, the summed failure-probability coefficient was 0.0027 in the post-FDICIA window, nearly identical to the 0.0024 coefficient in the baseline regression. The summed coefficient in the run-off equation was -0.1148, compared to -0.1235 in the baseline specification. Put plainly, federal depositor-preference legislation does not explain the absence of jumbo-CD discipline in the post-FDICIA era.

5.3 Liability substitution

Another potential explanation for the results is liability substitution. With samples drawn mostly from the pre-FDICIA era, Jordan (2000) and Billet, Garfinkel, and O'Neal (1998) document a tendency for risky banks to fund with uninsured deposits to escape debt-market discipline. In the post-FDICIA era, banks have been able to escape market discipline with another type of funding that contains no failure-risk premium—Federal Home Loan Bank (FHLB) advances (Stojanovic, Vaughan, and Yeager, 2001). The estimated failure-risk sensitivities for the post-FDICIA period may be low—and hence the change in risk sensitivity across the two sample periods negligible—because risky banks funded growth with insured deposits or FHLB advances.

We tested for liability substitution with regressions and matched pairs. First, we regressed the ratio of non-risk-priced funding (insured deposits and FHLB advances) to risk-priced funding (foreign deposits, jumbo CDs, and subordinated debt) on the explanatory variables in the baseline yield and run-off specifications. A large, positive summed failure-risk coefficient would be consistent with liability substitution. But the summed coefficient for failure probability was negative and strongly significant before and after FDICIA, suggesting that, if anything, risky banks substituted in favor of risk-priced funding. One possible explanation is that risky banks—which are typically fast growing—booked commercial loans faster than they could raise insured deposits or invest in assets eligible to secure FHLB advances. This effect would not have shown up in previous studies because Billet et al. looked at larger, more stable (i.e., slow-growing) holding companies, and Jordan looked at banks with one foot in the grave.[8] As a further test, we tracked jumbo-CD usage for banks that did and did not join the FHLB System. Specifically, for each sample bank that joined between 1993 and 1995, we assigned a peer based on asset size, geographic location, and initial risk level. We then followed the 1,743 matched pairs for two years. FHLB members did grow slightly riskier: average SEER failure probability rose 10 basis points relative to non-member peers over the two-year interval (difference significant at the 5 percent level). At the same time, the jumbo-CD-to-total-asset ratio increased by 1.51 percent for joiners and 1.46 percent for non-joiners (difference not statistically significant). In short, the evidence does not support the notion that liability substitution undermined jumbo-CD discipline in the post-FDICIA era.

6. Policy implications

The evidence presented here weakens the case for debt-market discipline as a pillar of bank supervision. The price of risk in the jumbo-CD market is so small that even bank managers devoted to maximizing shareholder value will not be deterred from risk taking. Now, it is true that the concrete proposals for operationalizing market discipline as a supervisory pillar have concentrated on subordinated debt rather than jumbo CDs. [For example, see Lang and Robertson (2002), Evanoff and Wall (2000), and Calomiris (1997).] Still, forcing banking organizations to issue subordinated debt in a standardized form is an implicit capital-structure tax. Before imposing such a tax, policymakers should adduce evidence that subordinated debt will produce the desired discipline. For most banks, jumbo-CDs are junior liabilities—like subordinated debt at large banking organizations—and the jumbo-CD market's response to FDICIA suggests that subordinated debt may not produce the desired check on risk.[9]

The evidence also carries implications for the current debate over raising the deposit-insurance ceiling. In the 1990s, large banks merged at a record pace, producing sizable cost savings and putting

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8. Weakly capitalized banks cannot secure new brokered deposits or FHLB advances without the explicit permission of their lead supervisor.

9. Three liabilities are junior to jumbo CDs: foreign deposits, other unsecured general-creditor claims, and subordinated debt (which includes commercial paper). At year-end 2002, the average commercial bank funded 0.72 percent of assets with these liabilities, and 81.9 percent of U.S. banks had none of the three in their funding mix.

intense pressure on community banks to cut expenses. At the same time, community banks lost consumer loans and retail deposits to tax-exempt credit unions. Community bankers contend that a higher coverage ceiling would improve their ability to lure retirement accounts and municipal deposits away from large banks (ICBA, 2000). And, they note that inflation has eroded the real value of coverage considerably since 1980. Economists have countered that raising the deposit-insurance ceiling would exacerbate moral hazard by weakening depositor pressure on banks to contain risk (Vaughan and Wheelock, 2002). The evidence presented here suggests that pressure to contain risk from the jumbo-CD market is already minimal, so raising the coverage ceiling should not exacerbate moral hazard—at least in the current institutional and economic environment.

7. Conclusions

The Federal Deposit Insurance Corporation Improvement Act of 1991 eliminated "too big to fail" and directed the FDIC to resolve bank failures in the least-costly manner. These changes exposed jumbo-CD holders to greater losses from bank failures. We examined the sensitivity of jumbo-CD yields and run-offs to failure risk before and after FDICIA, gauging the implied impact of risk on bank profits across the regime change. The results indicate that yield and run-off were risk sensitive, but the estimated failure-probability coefficients for the pre- and post-Act samples were small. More to the point, these coefficients were not statistically or economically different across the two sample periods. In short, the evidence suggests that the jumbo-CD market put little pressure on banks to contain risk before FDICIA and that FDICIA did not intensify that pressure.

Frictions could explain the absence of effective discipline in the jumbo-CD market. Jumbo-CD rates may "cluster" around integers and even fractions (Kahn, Pennacchi, and Sopranzetti, 1999); such clustering would make rates less responsive to changes in bank risk. Similarly, jumbo-CD holders may also receive other services—commercial loans and checking services, for example—from their bank and, thus, price the relationship comprehensively rather than CDs individually. A final possibility is that jumbo-CD holders are simply noise traders, giving little thought to failure risk when deciding where to place their funds.

Market frictions are likely not the sole cause of weak discipline in the jumbo-CD market; the long robust business-cycle expansion of the 1990s probably also plays a role. Over this period, bank profitability and capital ratios soared to record highs while failure rates plummeted to record lows. In such an environment, jumbo-CD yields and run-off were unlikely to react strongly to failure risk because the benefits of monitoring were so low. Put another way, losses given failure rose with the elimination of "too big to fail" and the implementation of least-cost resolution, but at the same time probability of failure plunged (see Figure 2). Thus, expected losses—the variable motivating jumbo-CD holders to monitor and discipline risk—may actually have fallen. This explanation would account for the successful use of average yields in bank-risk studies in the 1980s, a time when financial distress was fairly common and failures were sharply rising.

Another possible explanation for weak jumbo-CD discipline is that financial markets punish risky institutions through another channel—perhaps market-imposed capital requirements. Indeed, Flannery and Rangan (2002) argue that financial markets are responsible for the capital buildup among large complex banking organizations in the 1990s, that bank stakeholders now insist on a greater capital cushion to cover increasingly sophisticated risk exposures. Even if this conjecture proves correct, it would not undermine the importance of the evidence presented here. Policy discussion to date has focused on discipline imposed directly by debt markets. And this discussion has implicitly assumed that debt-market discipline is equally effective in all states of the world. Our evidence—that jumbo-CD discipline is weak and likely even weaker in good banking times—may necessitate reappraisal of debt-market discipline as a supervisory pillar. When viewed with the Flannery-Rangan evidence, our findings suggest that future market-discipline research should focus on identifying the specific bank claims that yield the most supervisory value in each state of the business cycle.

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Table 1

Does extant evidence point to risk pricing by jumbo-CD holders?

This table summarizes the extant literature on risk pricing by jumbo-CD holders. (We use the term "bank" to refer to bank holding companies as well as banks and the term "risk pricing" to refer to a price or quantity response to a change in risk.) These studies employed both cross-section and time-series techniques and exploited a variety of risk proxies and control variables. Overall, the evidence suggests that jumbo-CD holders price bank risk, though in most cases statistical significance of risk variables was interpreted as economic significance. In addition, most of this research relied on pre-FDICIA samples.

Study	Sample Period	Country	Instrument	Number of Institutions	Yield or Run-off?	Risk Pricing?
Crane (1976)	1974	U.S.	Bank Jumbo CDs	24	Yield	Somewhat
Goldberg and Lloyd-Davies (1985)	1976 – 82	U.S.	Bank Jumbo CDs	25	Yield	Yes
Baer and Brewer (1986)	1979 – 82	U.S.	Bank Jumbo CDs	40	Yield	Yes
James (1988)	1984 – 86	U.S.	Bank Jumbo CDs	58	Yield	Yes
Hannan and Hanweck (1988)	1980 – 84	U.S.	Bank Jumbo CDs	~200	Yield	Yes
Cargill (1989)	1984 – 86	U.S.	Bank Jumbo CDs	58	Yield	Yes
Keeley (1990)	1971 – 86	U.S.	Bank Jumbo CDs	85	Yield	Yes
Ellis and Flannery (1992)	1982 – 88	U.S.	Bank Jumbo CDs	6	Yield	Yes
Cook and Spellman (1994)	1987 – 88	U.S.	Thrift Jumbo CDs	~200	Yield	Yes
Crabbe and Post (1994)	1986 – 91	U.S.	Bank Jumbo CDs	41	Run-off	No
Brewer and Mondschean (1994)	1987 – 89	U.S.	Thrift Jumbo CDs	4	Yield	Yes
Park (1995)	1985 – 92	U.S.	Bank Jumbo CDs	~10,000	Both	Yes
Park and Peristiani (1998)	1986 – 90	U.S.	Thrift Jumbo CDs	~3,000	Both	Yes
Jordan (2000)	1989 – 95	U.S.	Bank Jumbo CDs	65	Both	Yes
Martinez Peria and Schmuckler (2001)	1981- 97	Argentina, Chile, Mexico	Bank Jumbo CDs	~200	Both	Yes
Goldberg and Hudgins (2002)	1984 - 94	U.S.	Thrift jumbo CDs	619	Run-off	Yes

Table 2

Does jumbo-CD run-off at failing banks reflect supervisor discipline or market discipline?

In the quarters approaching failure, troubled banks face intense supervisory pressure to improve their capital ratios. Such banks can quickly raise capital ratios by allowing high-priced funding—such as jumbo CDs—and low-yield loans to run off. Observed changes in jumbo-CD dependence may, therefore, reflect supervisor rather than market discipline. This table illustrates the potential for observational equivalence in a sample of banks supervised by the Federal Reserve. In the 1990s, 28 Fed-supervised banks failed; 24 were operating under safety-and-soundness-related enforcement actions at failure. The average age of these actions was 6.8 quarters. Mean and median quarterly growth rates show a consistent pattern of high loan and deposit growth two to three years before failure. About the time enforcement actions were imposed, however, loan and deposit growth started declining, later turning negative. The final two columns show that the jumbo-CD-to-total-deposit ratio also tumbled after imposition of enforcement actions. As a benchmark for each series, the last row displays the average quarterly growth rates in the 1990s for all Fed-supervised banks.

Quarters to Failure (1)	Number of Failing Banks under Actions (2)	Mean Loan Growth (3)	Median Loan Growth (4)	Mean Deposit Growth (5)	Median Deposit Growth (6)	Mean Jumbo-CD Growth (7)	Median Jumbo-CD Growth (8)	Mean Jumbo-CD-to-Deposits Ratio (9)	Median Jumbo-CD-to-Deposits Ratio (9)
12	22	3.65	3.63	4.75	2.54	5.99	1.11	28.29	24.93
11	22	1.97	0.75	5.60	2.68	2.57	0.53	19.00	12.12
10	22	3.19	3.24	5.04	2.03	7.70	-1.10	15.66	3.95
9	23	6.47	1.45	8.39	2.61	7.42	-5.35	29.25	32.32
8	23	9.25	1.02	5.32	-1.04	8.41	0.02	29.34	30.34
7	24	11.29	-0.17	2.97	1.78	1.14	-3.66	16.76	8.08
6	24	12.98	0.74	1.37	0.42	-3.20	0.23	17.25	15.07
5	24	3.68	-2.65	0.47	-3.31	-6.62	-10.08	23.74	21.40
4	24	-1.87	-2.77	-1.96	-2.81	-7.00	-9.09	17.46	9.35
3	24	-1.79	-3.10	-2.43	-1.95	-5.95	-9.62	14.45	7.24
2	24	-4.86	-5.01	-2.04	-2.40	-5.00	-6.04	11.99	6.21
1	24	-7.02	-5.74	-4.33	-4.71	-12.33	-11.36	13.09	7.29
0	17	-8.99	-9.63	-8.03	-7.83	-17.14	-16.63	8.70	4.98
All Fed-Supervised Banks		**8.27**	**2.05**	**4.14**	**1.31**	**6.61**	**0.84**	**14.23**	**10.81**

Table 3

What are the SEER failure-prediction variables?

This table lists the independent variables in the SEER (System to Estimate Examination Ratings) model. The signs indicate the hypothesized relationship between each variable and failure probability over the next two years. For example, the negative sign for the net-income (ROA) ratio indicates that an increase in earnings reduces failure probability, other things equal. We use the SEER failure probability as a summary statistic for bank risk in the jumbo-CD yield and run-off regressions.

Independent Variable		Effect on failure probability
Credit Risk	Loans past due 30 to 89 days / total assets	+
	Loans past due 90+ days / total assets	+
	Nonaccruing loans / total assets	+
	Other real estate owned (OREO) / total assets	+
	Commercial and industrial loans / total assets	+
	Residential real estate loans / total assets	–
Leverage Risk	Tangible capital / total assets	–
	Net income / average assets (ROA)	–
Liquidity Risk	Jumbo certificates of deposit / total assets	–
	Book value of securities / total assets	+
Control Variable	Natural log of total assets	–

"+" indicates that higher levels of the variable lead to higher probabilities of failure; "–" indicates the opposite.
Table adapted from Cole, Cornyn, and Gunther (1995).

Table 4

What is held constant in the jumbo-CD yield and run-off regressions?

We opted for ordinary least squares with an expansive set of control variables rather than fixed effects because most sample variation is across banks, and fixed effects would sweep out much of this variation. To find suitable controls, we conducted a fresh specification search, starting with a list of candidate variables drawn from examiner suggestions, previous jumbo-CD research, and related market-discipline studies. This table lists the results of the specification search—that is, the specific control variables used in the baseline regressions and the rationale for each variable.

Control Variable	**Reason for Inclusion**
Percentage of Fixed-Rate Jumbo CDs	• Controls for the percentage of the bank's jumbo-CD portfolio with a fixed (as opposed to variable) interest rate. • Included because differing exposures to interest-rate risk could affect yields.
Maturity-Weighted Treasury Yield	• Controls for the term premium paid by the bank as well as the general level of interest rates. • Included to remove impact of maturity and money-market conditions on yields.
Average Maturity of Jumbo-CD Portfolio	• Controls for the term and illiquidity premiums paid by the bank. • Included to remove impact of maturity and money-market conditions on yields. Also, yields respond more quickly to changes in market rates and failure probabilities when average maturity is shorter.
Maturity-Treasury Interactive (product of two-quarter lag of portfolio maturity and two-quarter change in maturity-adjusted risk-free rate.)	• Controls for the term and illiquidity premiums paid by the bank. • Included to remove impact of maturity and money-market conditions on yields. Also, yields respond more quickly to changes in market rates and failure probabilities when average maturity is shorter.
Negotiability Dummy ("1" if top 25 bank)	• Controls for presence of negotiable instruments in the bank's jumbo-CD portfolio. • Included because negotiability should reduce yield. Dummy used because only large, money-center banks routinely issue negotiable CDs.
Holding-Company Dummy ("1" if bank-holding-company affiliation)	• Controls for impact of holding-company affiliation on expected losses to jumbo-CD holders. • Included because perception of the bank's holding company—as a source of strength or weakness—could affect yield.
Brokered-Deposit Dummy ("1" if brokered-deposit user)	• Controls for the bank's need for extra-market funding. • Included because reliance on extra-market funding should tighten link between risk and yield. Dummy employed because use of brokered deposits is strong evidence that the bank's funding demands exceed local supply.
MSA Dummy ("1" if urban)	• Control for impact of the bank's deposit-market structure. • Included because rural banks face less deposit competition and may be able to pay less than the going jumbo-CD rate.
State Dummies	• Control for differences in regional economic conditions, state banking laws, and state income-tax codes.
Quarter Dummies	• Controls for changes in deposit and money-market conditions, macro-economic conditions, jumbo-CD reserve requirements, and FDIC condition.

Table 5

How do the pre- and post-FDICIA samples differ?

This table provides summary statistics for the pre- and post-FDICIA samples. Except for the percentage of banks among the largest 25 and the percentage of banks in holding companies, all differences in means across sample periods are significant at the one-percent level. The data reveal that jumbo-CD yields declined with money-market rates from the pre- to post-FDICIA periods. Bank condition also improved after FDICIA, reflecting Basle-mandated increases in capital ratios, exit of weakly capitalized institutions, and recovery from the 1990-91 recession. Declines in failure probabilities can be traced to less commercial lending, stronger asset quality, lower liquidity risk, and lower leverage risk. Another risk-reducing factor was size; post-FDICIA banks were larger than pre-FDICIA banks, reflecting industry consolidation. Finally, on average post-FDICIA banks used less jumbo-CD funding than pre-FDICIA banks, largely due to higher capital requirements. Even with the post-FDICIA improvement in banking conditions, the sample is heterogeneous in both windows. For the 1988-90 sample, the standard deviation of failure probability is 15.70 percentage points (mean 5.04 percent), implying a coefficient of variation of 3.12. For 1993-95, the standard deviation is 8.15 percent, yielding a coefficient of variation of 6.57. Interestingly, summary statistics for the satisfactory-CAMEL sub-sample (not shown) reveal heterogeneity among safe-and-sound banks. The pre-FDICIA coefficient of variation for failure probability is 4.14 while the post-FDICIA figure is 7.35.

Variable		***Pre-FDICIA (1988 – 1990) 48,056 observations***			***Post-FDICIA (1993 – 1995) 46,649 observations***		
		Median	**Mean**	**Std. Dev.**	**Median**	**Mean**	**Std. Dev.**
Dependent Variables							
Jumbo-CD yield (%)		7.98	7.97	1.90	4.48	4.60	1.29
Jumbo-CD growth rate (run-off) (%)		0.83	2.51	18.41	1.43	3.73	19.62
Risk Variables – Failure Probabilities and their Components							
SEER Failure Probability **(%)**		0.24	5.04	15.70	0.02	1.24	8.15
Credit Risk	Loans past due 30 to 89 days / total assets (%)	0.99	1.26	1.12	0.67	0.86	0.78
	Loans past due 90+ days / total assets (%)	0.20	0.40	0.63	0.07	0.19	0.41
	Nonaccruing loans / total assets (%)	0.48	0.93	1.40	0.28	0.57	0.95
	Other real estate owned (OREO) / total assets (%)	0.19	0.70	1.43	0.10	0.37	0.95
	Commercial and industrial loans / total assets (%)	11.79	13.62	8.77	8.89	10.63	7.65
	Residential real estate loans / total assets (%)	12.69	14.31	9.37	15.27	16.68	10.40
Leverage Risk	Tangible capital / total assets (%)	7.49	7.78	2.74	8.46	9.05	2.69
	Net income / average assets (%)	0.99	0.73	1.33	1.23	1.18	0.83
Liquidity Risk	Jumbo certificates of deposits / total assets (%)	13.17	14.64	7.85	9.39	10.60	6.39
	Book value of securities / total assets (%)	24.05	26.15	14.47	28.79	30.85	15.01

Table 5
How do the Pre- and Post-FDICIA samples differ?
(Continued)

Variable	*Pre-FDICIA (1988 – 1990) 48,056 observations*			*Post-FDICIA (1993 – 1995) 46,649 observations*		
	Median	**Mean**	**Std. Dev.**	**Median**	**Mean**	**Std. Dev.**
Control Variables						
Total assets (in thousands of $)	109,367	581,679	3,871,942	131,794	761,367	5,432,540
Percentage of fixed-rate jumbo CDs	100.00	98.61	6.31	100.00	98.17	7.14
Maturity-weighted Treasury yield (%)	8.08	8.01	0.58	5.34	4.91	1.16
Weighted-average maturity (in years)	0.46	0.53	0.30	0.76	0.85	0.46
Maturity-Treasury volatility interactive term	0.04	0.12	0.55	0.10	0.32	0.65
Percentage of sample banks in top 25 (by assets)	0.00			0.01*		
Percentage of sample banks in holding companies	0.81			0.80*		
Percentage of sample banks using brokered deposits	0.10			0.13		
Percentage of sample banks in MSAs	0.61			0.58		

* The difference between the pre- and post-FDICIA statistic is statistically indistinguishable from zero.

Table 6

Did failure risk affect jumbo-CD yields?

Equation (1) Regression Results
Pre- and Post-FDICIA

This table reports results for regressions of jumbo-CD yields on SEER failure probabilities and control variables. Coefficients on the quarter and state dummies are not reported. Asterisks indicate statistical significance at the ten- (*), five- (**), and one- (***) percent levels. Positive and significant summed coefficients constitute evidence of jumbo-CD discipline; a statistically significant increase in summed coefficients constitutes evidence of stronger discipline following FDICIA. The evidence points to some discipline before and after the Act—banks with higher failure risk paid more on jumbo CDs in both periods. Coefficient magnitudes suggest, however, that this discipline was economically unimportant. In the pre-FDICIA period, a one-percentage-point increase in failure probability boosted jumbo-CD yields by only 0.34 basis points. In the post-FDICIA period, a one-percentage-point increase raised yields by only 0.24 basis points. The difference in summed coefficients across the two windows is negative (unexpected sign) but not statistically significant, suggesting that FDICIA had no discernable impact on jumbo-CD discipline though the yield channel.

	1988 – 1990 (Pre-FDICIA)			**1993 – 1995 (Post-FDICIA)**		
Independent Variable	**Coeff.**	**Std. Err.**		**Coeff.**	**Std. Err.**	
Lags 1, 2, and 3 of SEER failure Probability (With Sum)	0.0002 0.0011 0.0020 **0.0034**	0.0017 0.0023 0.0017 **0.0006**	 ***	0.0028 -0.0004 -0.0000 **0.0024**	0.0018 0.0025 0.0017 **0.0006**	 ***
Percentage of fixed-rate CDs	-0.0005	0.0014		-0.0060	0.0007	***
Maturity-weighted Treasury yield	0.8204	0.1118	***	0.8207	0.0367	***
Average portfolio maturity	0.0261	0.0382		0.1366	0.0212	***
Maturity-Treasury interactive	-0.1443	0.0317	***	-0.1945	0.0160	***
Negotiability dummy	-0.1830	0.1268		-0.4243	0.0659	***
Holding-company dummy	0.0079	0.0220		-0.0595	0.0123	***
Brokered-deposit dummy	0.2456	0.0299	***	0.1537	0.0146	***
MSA dummy	0.0330	0.0192	*	-0.0474	0.0103	***
R^2	0.0835			0.4125		
F-statistic control variables	22.23		***	355.61		***
F-statistic quarter dummies	68.12		***	279.15		***
F-statistic state dummies	12.96		***	27.66		***
Observations	48,056			46,649		

Table 7

Did failure risk affect jumbo-CD run-off?

Equation (2) Regression Results
Pre- and Post-FDICIA

This table reports results for regressions of jumbo-CD growth rates on SEER failure probabilities and control variables. Coefficients on the quarter and state dummies are not reported. Asterisks indicate statistical significance at the ten- (*), five- (**), and one- (***) percent levels. Negative and significant summed coefficients constitute evidence of jumbo-CD discipline; a statistically significant increase in summed coefficients constitutes evidence of stronger discipline following FDICIA. The evidence points to some discipline before and after the Act—banks with higher failure risk did experience slower jumbo-CD growth (or greater run-off) in both periods. Coefficient magnitudes suggest, however, that this discipline was economically unimportant. In the pre-FDICIA period, a one-percentage-point increase in failure probability reduced jumbo-CD growth by 11 basis points. In the post-FDICIA period, a one-percentage-point lowered growth by 12 basis points. The increase in summed coefficients across the two windows is not statistically significant, suggesting that FDICIA had no discernable impact on jumbo-CD discipline though the run-off channel.

	1988 – 1990 (Pre-FDICIA)			**1993 – 1995 (Post-FDICIA)**		
Independent Variable	**Coeff.**	**Std. Err.**		**Coeff.**	**Std. Err.**	
Lags 1, 2, and 3 of SEER failure Probability (With Sum)	-0.1402 0.0008 0.0260 **-0.1133**	0.0167 0.0227 0.0170 **0.0061**	*** ***	-0.0803 -0.0415 -0.0017 **-0.1235**	0.0358 0.0486 0.0335 **0.0118**	** ***
Percentage of fixed-rate CDs	0.0528	0.0137	***	0.0121	0.0127	
Maturity-weighted Treasury yield	-4.4175	1.1096	***	-3.3355	0.7141	***
Average portfolio maturity	-0.0455	0.3796		-1.0158	0.4114	**
Maturity-Treasury interactive	0.5796	0.3147	*	3.4265	0.3105	***
Negotiability dummy	-1.2659	1.2588		-2.4828	1.2810	*
Holding-company dummy	-0.1309	0.2185		0.1013	0.2392	
Brokered-deposit dummy	-0.6510	0.2971	**	0.6417	0.2833	**
MSA dummy	-0.1462	0.1910		0.2771	0.2008	
R^2	0.0369			0.0362		
F-statistic control variables	6.72		***	23.24		***
F-statistic quarter dummies	43.11		***	32.07		***
F-statistic state dummies	9.71		***	4.51		***
Observations	48,056			46,649		

Table 8

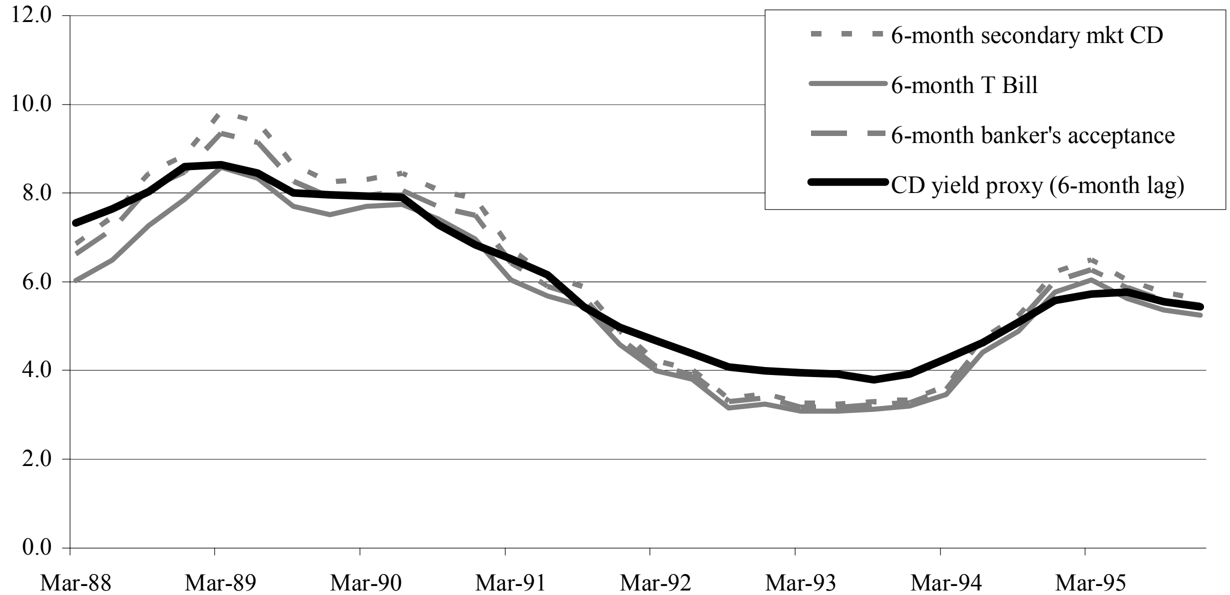
Did unsatisfactory-CAMEL banks affect the results?

"Unsatisfactory" banks in the sample introduce the potential for an observational-equivalence problem—deposit run-off could reflect supervisor discipline, market discipline, or both. This problem does not appear to be serious here because estimated risk sensitivities are small. But supervisor control over unsatisfactory banks could bias the SEER coefficients, accounting in part for small failure-risk sensitivities. Eliminating such banks removes this potential bias and, more importantly, reveals how much pressure the jumbo-CD market brought to bear on banks prior to supervisory intervention in the pre-FDICIA and post-FDICIA windows. This table contains summed failure-probability coefficients for the full sample, the satisfactory-CAMEL sub-sample, and the unsatisfactory-CAMEL sub-sample. Removing unsatisfactory-CAMEL banks sharpens coefficient estimates, increasing the risk sensitivities in each sample window and the differences across the windows. It does not, however, alter the conclusions derived from tests on the full sample—risk pricing was economically unimportant in the jumbo-CD market before FDICIA and FDICIA did little to change that fact.

Jumbo-CD Yield Regressions				
Sample Includes:	**Observations**	**Summed SEER Coefficients (Pre-FDICIA)**	**Observations**	**Summed SEER Coefficients (Post-FDICIA)**
Banks with all ratings (baseline)	48,056	0.0034 ***	46,649	0.0024 ***
1-, and 2-rated banks only	37,717	0.0061 **	42,518	0.0120 ***
3-, 4-, and 5-rated banks only	10,339	0.0026 ***	4,131	0.0006

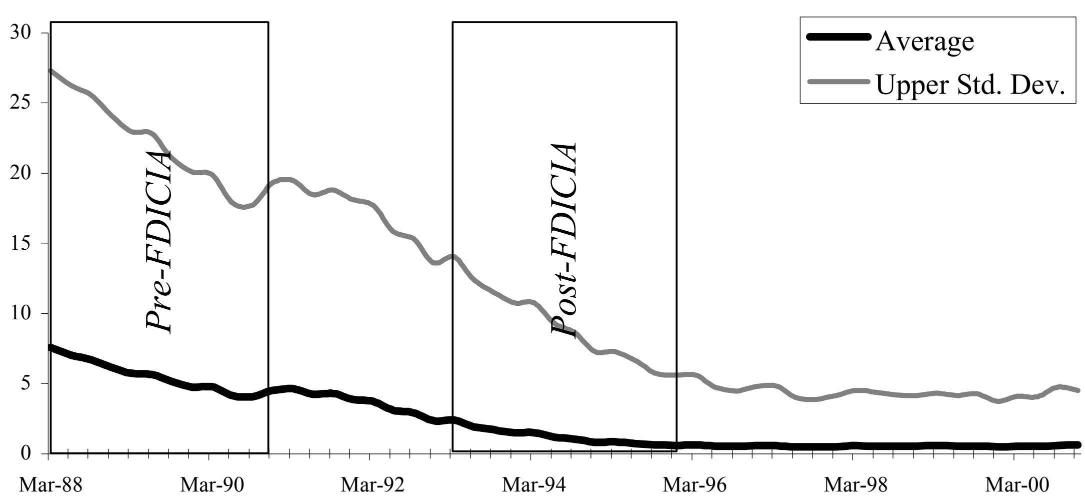
Jumbo-CD Growth Regressions				
Sample Includes	**Observations**	**Summed SEER Coefficients (Pre-FDICIA)**	**Observations**	**Summed SEER Coefficients (Post-FDICIA)**
Banks with all ratings (baseline)	48,056	-0.1133 ***	46,649	-0.1235 ***
1-, and 2-rated banks only	37,717	-0.1323 ***	42,518	-0.1793 ***
3-, 4-, and 5-rated banks only	10,339	-0.0807 ***	4,131	-0.0811 ***

Figure 1. Yield proxy versus money-market rates



This figure compares the time-series variation of our measure of jumbo-CD yields with the variation of secondary-market yields on comparable instruments. For the money-market rates, we used the six-month maturity to match the average maturity of our sample CDs. Generally, average yields tracks the other interest rates closely, albeit with a lag. This close tracking suggests that our yield measure may be a good one.

Figure 2. SEER failure probabilities over time



The Federal Reserve uses SEER to generate failure probabilities for off-site surveillance. The figure above tracks the equally weighted average of SEER failure probabilities for all U.S. banks as well as the upper standard deviation from 1988 to 2002. Both average failure probability and the standard deviation of that probability dropped considerably in the 1990s. The dramatic decline in average failure probability and its standard deviation may have reduced the benefits of monitoring bank condition. Such a reduction could explain the weak jumbo-CD discipline in the post-FDICIA era.